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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/414,526 | 10/08/1999 | YEONG-KWAN KIM | SEC.637 | 3413 |

7590 05/09/2003

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EXAMINER

CLEVELAND, MICHAEL B

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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1762

29

DATE MAILED: 05/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|-------------------|--------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 09/414,526 | KIM ET AL. | |
| | Examiner | Art Unit | |
| | Michael Cleveland | 1762 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 March 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 15-27 is/are pending in the application.
 4a) Of the above claim(s) 20 and 26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 15-19, 21-25, 27 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

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DETAILED ACTION

Election/Restriction

1. Claims 20 and 26 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 15-18, 21-25, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. (Appl. Phys. Lett., 71, pp. 3604-3606, hereafter Kim) in view of Marcus et al. (U.S. Patent 5,169,579, hereafter '579) and Luryi (U.S. Patent 4,806,996, hereafter '996).

Claims 15, 17-18, 25, and 27: Kim teaches loading a silicon substrate into a reaction chamber,

cleaning to uniformly terminate the surface with atomic hydrogen,
dosing with TMA, which inherently chemisorbs to the surface,
purging with TMA, which inherently removes any physisorbed TMA,
and injecting water to react with the TMA to form an alumina film (p. 3604).

Kim does not teach uniformly terminating the surface bonds with oxygen atoms.

'579 teaches that a surface may be prepared for subsequent film growth (See col. 3, lines 39-68) by modifying the surface to terminate in bonds to either hydrogen or oxygen (col. 7, lines 23-39). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have initially uniformly terminated the surface of the silicon substrate of Kim with oxygen instead of hydrogen with the expectation of similar results. '579 teaches that the oxygen-terminated surface may be achieved by exposure to oxygen, but does not explicitly state that the surface is flushed with oxygen. However, '996 teaches that a silicon surface may be oxidized (i.e., terminated with oxygen atoms) by treating with dry oxygen at 300 °C (col. 3, lines 62-65). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have providing the oxygen to terminate the surface by flushing with

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oxygen as described in '996 with a reasonable expectation of success. Such oxygen must inherently be part of the ALE-formed film.

Claim 16: The purging steps inherently remove physisorbed material. (Applicant recognizes that the feature achieved by purging, for instance, at p. 11, lines 6-11).

Claim 21: Kim teaches that the substrate may be cleaned of a native oxide before being loaded into the chamber, but does not explicitly state that the cleaning step comes before loading the substrate into the chamber. However, it appears that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have provided the cleaning step before loading the substrate into the ALD chamber in order to avoid damage to and contaminants in the ALD chamber by the HF used in the cleaning process.

Claim 22-23: A final purge inherently removes the by-products and any intermediates of the reaction (p. 3604, col. 2). Methane (CH_4) is a by-product of the reaction (p. 3604, col. 1).

Claim 24: The step of introducing oxygen must occur for finite period of time, and therefore that period can be subdivided into the first half of the time, during which oxygen is introduced the first time, and the second half of the time, during which oxygen is introduced a second time.

4. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of '579 and '996 as applied to claim 15 above, and further in view of Comizzoli et al. (U.S. Patent 5,851,849).

Kim, '579, and '996 suggest the formation of an alumina film by ALE, but do not explicitly teach the formation of other oxide films.

'849 teaches that other oxide films than alumina, such as TiO_2 , may be formed by ALE using other metal precursors (col. 7, lines 1-42).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the method of Kim, '579, and '751 to have formed a film of a different metal oxide, such as titania with a reasonable expectation of success because '849 teaches that the process can be adapted to other metal oxides, and indicates that those metal oxides are of interest as passivating films.

Response to Arguments

5. Applicant's arguments filed 8/26/2002 have been fully considered but they are not persuasive.

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Applicant argues that the Examiner has failed to address each of the reasons and manner of Kim for cleaning the wafer surface. This is an argument regarding Kim individually, and does not address the combination of references. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

To further explain, the specifics and reasons of Kim's cleaning process are not relevant to the rejection. Kim's cleaning process results in the termination of the substrate with hydrogen. Marcus teaches the equivalence of oxygen-termination with hydrogen-termination for the purpose of preparing a silicon substrate for subsequent film growth. The substitution of one equivalent for another has long been held to be *prima facie* obvious. See MPEP 2144.06.

Applicant states "The Examiner seems to contend that it would be obvious to terminate the wafer of Kim et al. with oxygen instead of hydrogen." The statement is confirmed: it would have been obvious to one of ordinary skill in the art at the time the invention was made to have terminated the wafer of Kim et al. with oxygen instead of hydrogen for the reasons given detailed above. Applicant argues that "the Examiner completely fails to explain how this would be done." The allegation is incorrect because the explanation is present in paragraph 3 (the same text was present in paragraph 4 in the prior Office action):

'579 teaches that the oxygen-terminated surface may be achieved by exposure to oxygen, but does not explicitly state that the surface is flushed with oxygen. However, '996 teaches that a silicon surface may be oxidized (i.e., terminated with oxygen atoms) by treating with dry oxygen at 300 °C (col. 3, lines 62-65). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have providing the oxygen to terminate the surface by flushing with oxygen as described in '996 with a reasonable expectation of success.

Applicant argues that there is no motivation in Marcus to modify the process. The argument is incorrect. The teaching of equivalence and the resulting expectation of similar results is sufficient motivation for the modification. See MPEP 2144.06.

Applicant argues that Kim is directed to ALD of alumina films and Marcus directed to laser deposition. Issofar as this appears to be an argument that Marcus is nonanalogous art, it has

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been held that a prior art reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the applicant was concerned, in order to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, Marcus is reasonably pertinent to the particular problem with which applicant was concerned because it is directed to the preparation of substrates for growth of films, such as alumina (i.e., the same film as that of Kim), from gas-phase precursors (ALD is a particular method for growing films from gas-phase precursors) (col. 3, lines 55-68).

Applicant argues that the reliance of Luryi is misplaced because Luryi teaches intentionally oxidizing a surface, whereas Kim removes an oxide (during hydrogen-termination). The argument does not address the combination of references because it ignores the teachings of Marcus, which suggest intentionally oxidizing the substrate.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael Cleveland whose telephone number is (703) 308-2331. The examiner can normally be reached on 9-5:30 M-F.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 306-3186 for regular communications and (703) 306-3186 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MXO

MBC

May 6, 2003



**SHRIVE P. BECK
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700**